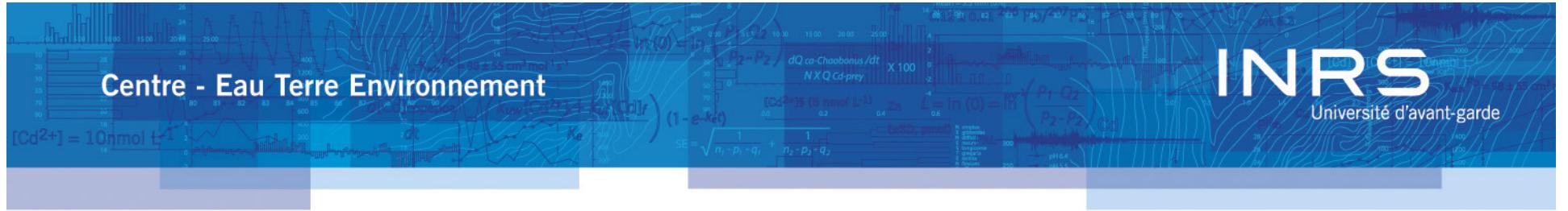


Water ressources monitoring

Monique Bernier and Karem Chokmani

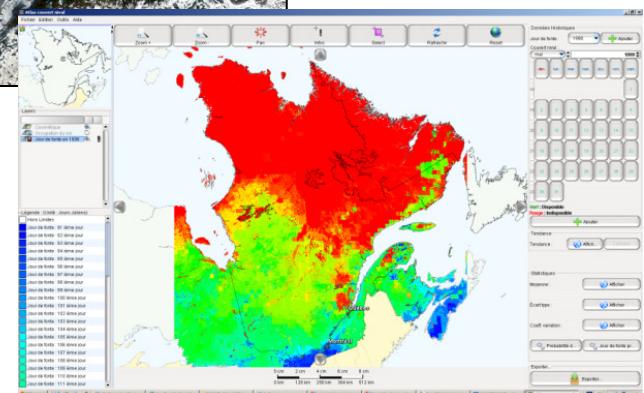
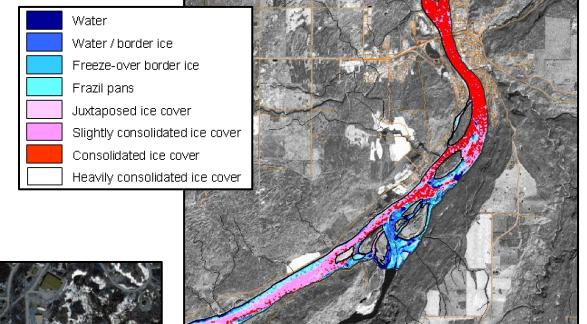
INRS
Université d'avant-garde

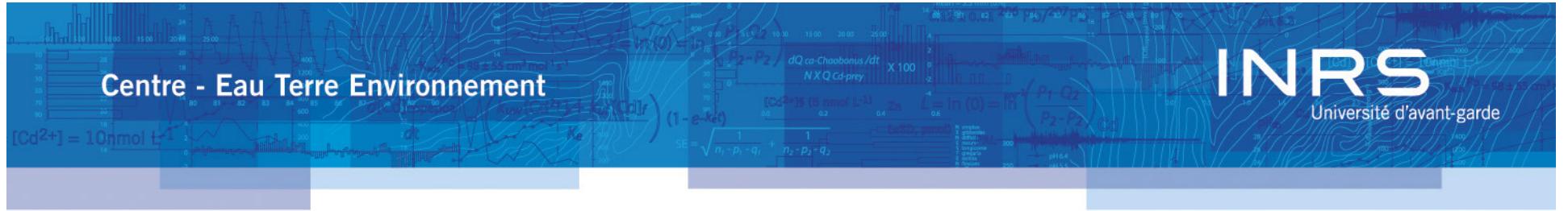
Centre - Eau Terre Environnement



Remote sensing expertise

- Calibration-Validation
 - Field measurements
 - Images processing
 - Inversion algorithms development
 - Mapping
 - Process automatisation
 - Radar signal modelisation

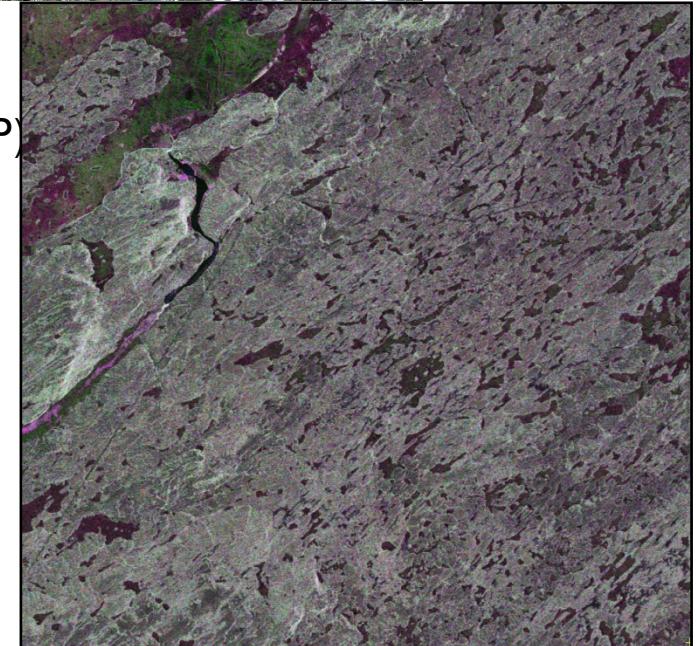




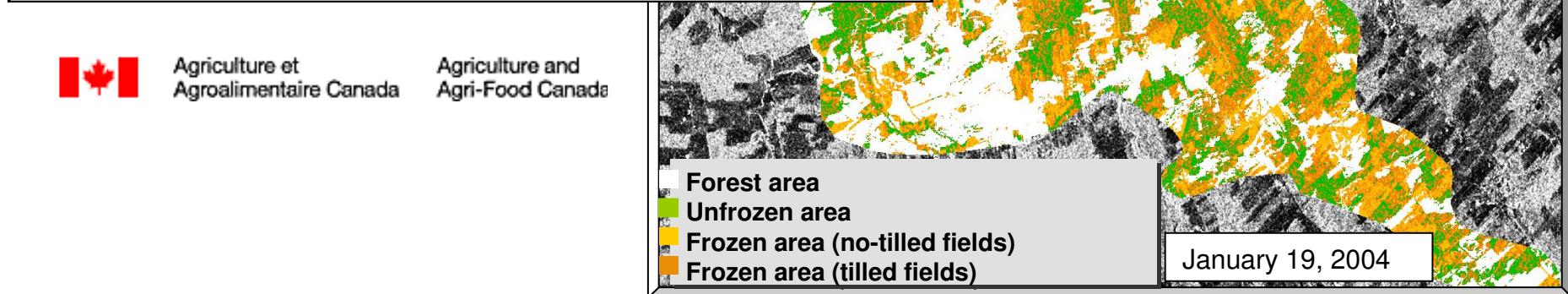
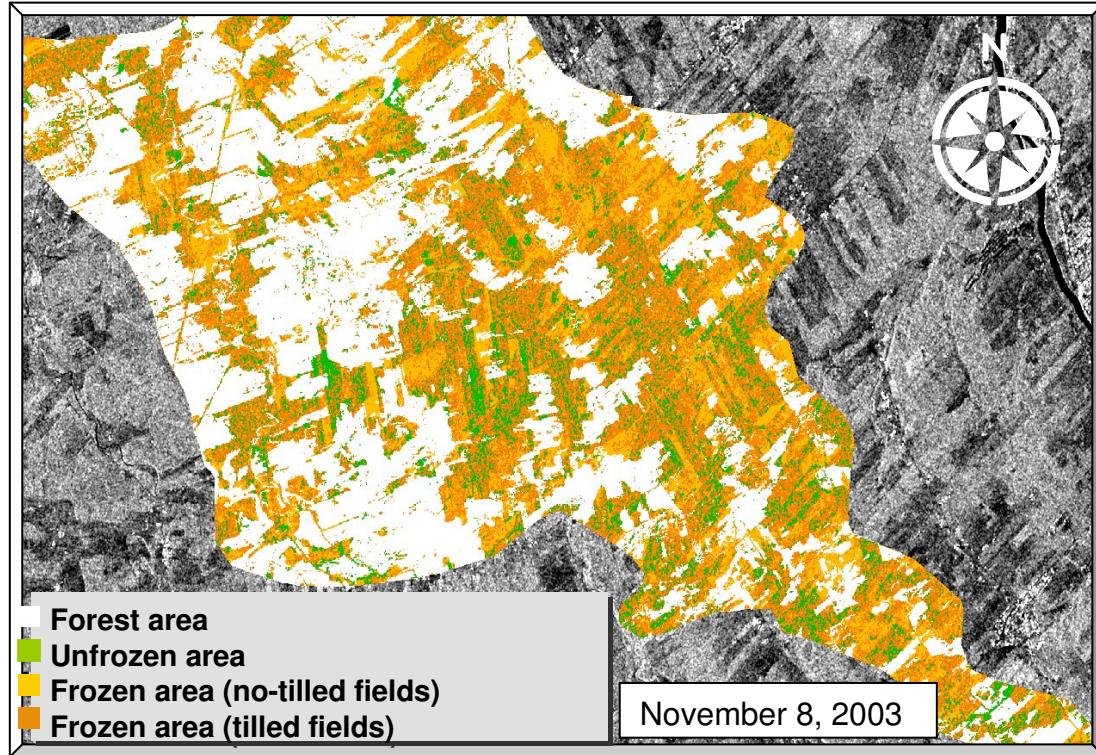
SMAP applications

➤ SAR Images

- **Data:** RADARSAT-1 et 2
- **Applications:**
 - ✓ Soil moisture monitoring and soil texture mapping in agriculture watershed (AAC-GRIP)
 - ✓ Frozen soil mapping (AAC-GRIP)
 - ✓ Wetland (Fen) monitoring (HQ, Ouranos)

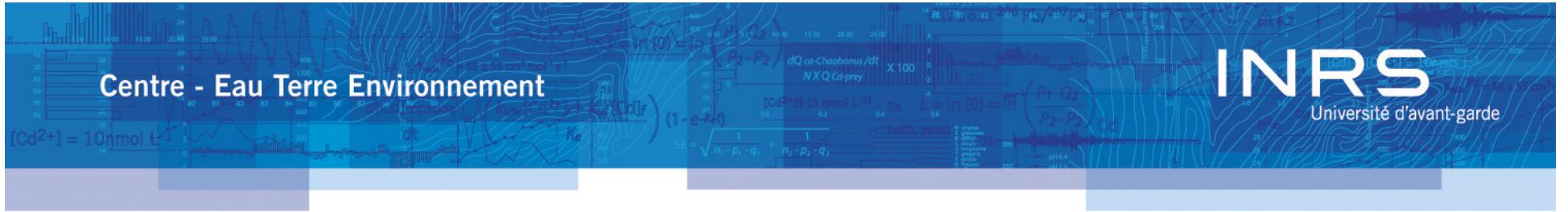


Mapping frozen ground Application in an agricultural watershed (near Quebec City)



Agriculture et
Agroalimentaire Canada

Agriculture and
Agri-Food Canada



CLIMB (FP7) Climate Induced Changes on the Hydrology of Mediterranean Basins – Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modeling System

Egypt, Sardegna, Tunisia, Turkey (2010-2014)

- (1) Ludwig-Maximilians-Universitaet Muenchen, LMU, Germany, the Coordinator
- (2) Agris Sardegna - Agenzia per la Ricerca in Agricoltura, AGRIS, Italy
- (3) Christian-Albrechts-Universitaet zu Kiel, CAU, Germany
- (4) Centre national du Machinisme Agricole, du Génie Rural, des Eaux et Forêts, Cemagref, France
- (5) Centre de Recherche et des Technologies des Eaux, CERTE, Tunisia
- (6) Consorzio Interuniversitario Nazionale per la Fisica delle Atmosfere e delle Idrosfere, CINFAI, Italy
- (7) Centro di Ricerca, Sviluppo e Studi Superiori in Sardegna, CRS4, Italy
- (8) Deutsches Zentrum für Luft- und Raumfahrt e.V., DLR, Germany
- (9) Forschungszentrum Juelich GmbH, Juelich, Germany
- (10) Gebze Yuksek Teknoloji Enstitusu, GIT, Turkey
- (11) Institut National de la Recherche Scientifique, INRS, Canada
- (12) Joanneum Research Forschungsgesellschaft mbH, Joanneum, Austria
- (13) Universite d'Angers, UA, France
- (14) Islamic University of Gaza, IUG, Palestinian-administered areas
- (15) Universita degli Studi di Padova, UNIPD, Italy
- (16) Universita degli Studi di Trento, UNITN, Italy
- (17) Zagazig University, UZ, Egypt
- (18) VISTA Geowissenschaftliche Fernerkundung GmbH, VISTA, Germany
- (19) Bayerische Forschungsallianz Gemeinnuetzige GmbH, BayFOR, Germany

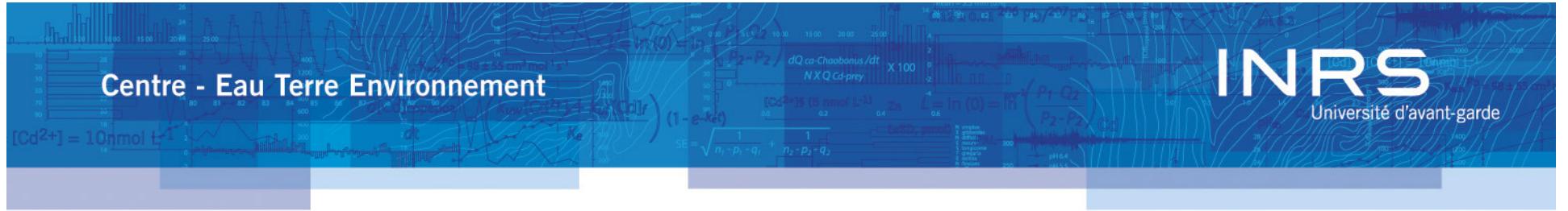
Monitoring Freeze-Thaw seasonal cycle in Nunavik

Monique Bernier and Parvin Kalantari
INRS - Institut National de la Recherche Scientifique

Soil Moisture Active and Passive (SMAP) Mission Workshop, 6-7 October 2009

Centre - Eau Terre Environnement

INRS
Université d'avant-garde



CRYSYS IPY sub-project:



Seasonal Soil Freezing Detection from Active and Passive Microwave - Application to the Tundra in Northern Quebec, Nunavik.

Objectives:

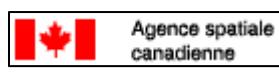
- Develop a mapping algorithm and provide input for climate and surface scheme models.
 - Make available the maps and field data to local communities via the CCIN and IPY site.

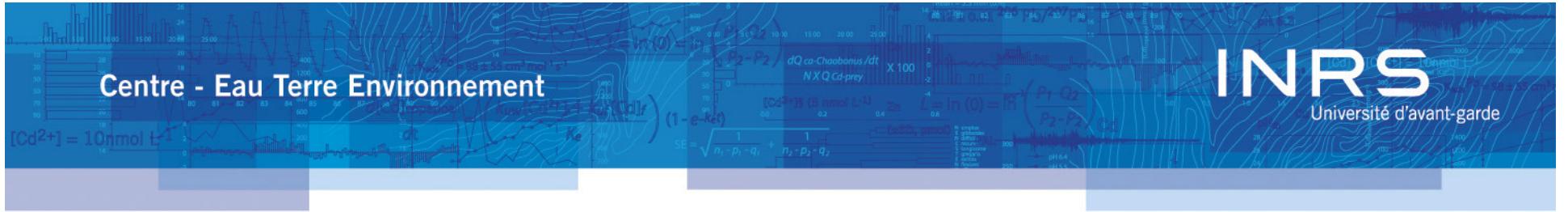
Funded by :

Government of Canada Program for the International Polar Year

In partnership with:

Environment Canada (MSC, Ottawa), the Canadian Space Agency, Kativik Regional Government and the Centre d'Études Nordiques





Rationale:

- Seasonal frozen ground is an integral component of the cryosphere-climate system.
- Freezing-thaw cycles in high latitudes influence the energy fluxes between the soil and the atmosphere, the annual productivity of these sensitive ecosystems and the carbon cycle.
- Frozen ground also plays an important role over the water balance by modifying surface runoff and soil infiltration.
- Remote sensing is the only tool available to monitor on a large scale, the seasonal frozen ground extent and evolution.



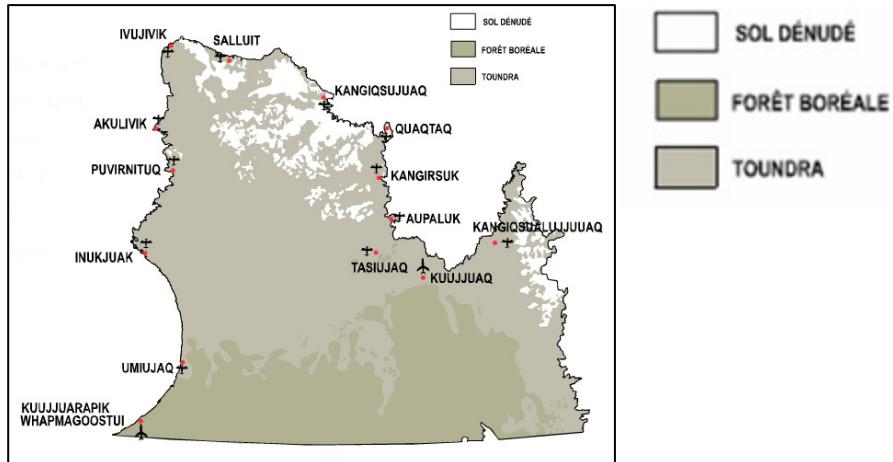
NUNAVIK



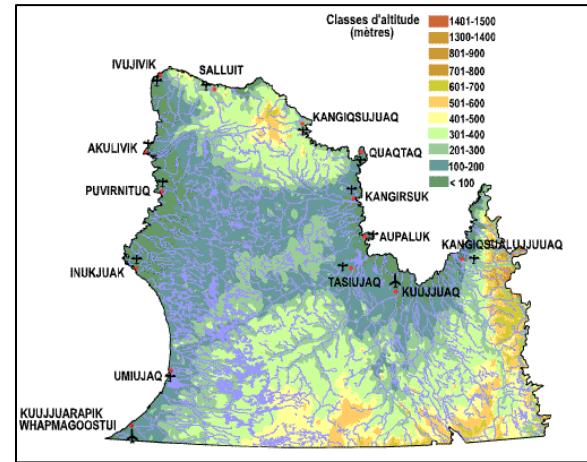
- Quebec's arctic region.
- 507 000 km².
- North of the 55th parallel.
- Tundra and taiga forest.
- Numerous lakes and large rivers.
- **Kuujjuaq** is the administrative center of Nunavik, is located right on the tree line.



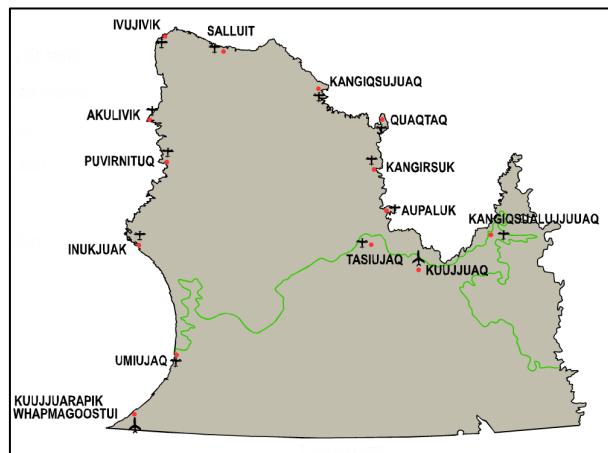
Vegetation of Nunavik



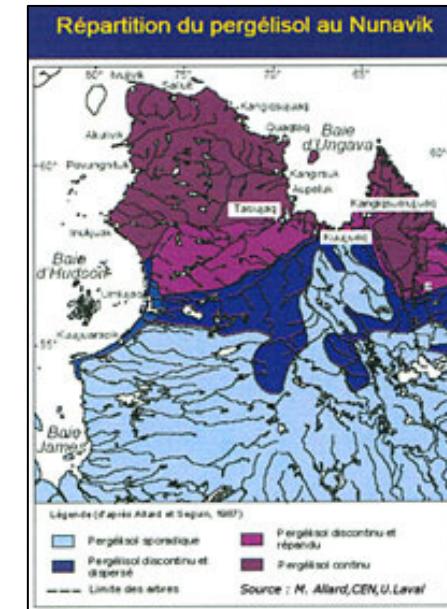
Relief of Nunavik

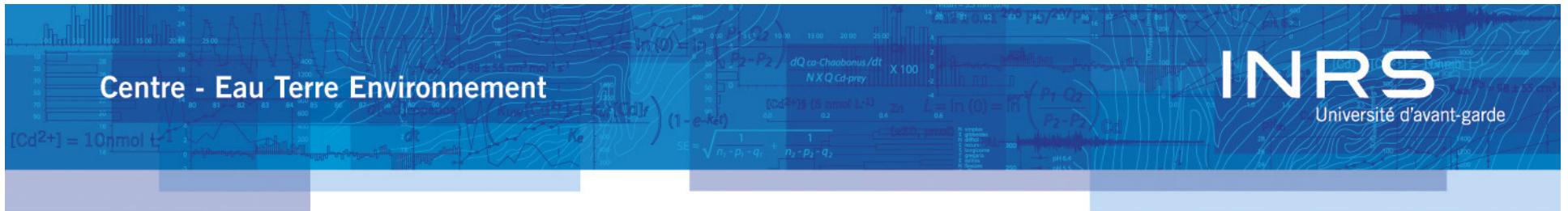


Tree Line



Permafrost map



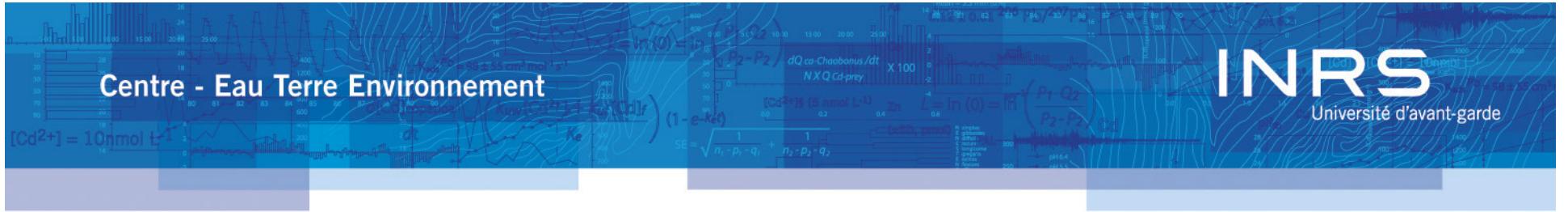


58°10.006N ; 68°22.441W
Ouvert, versant sud colline
Matières organiques
Mousse et lichen



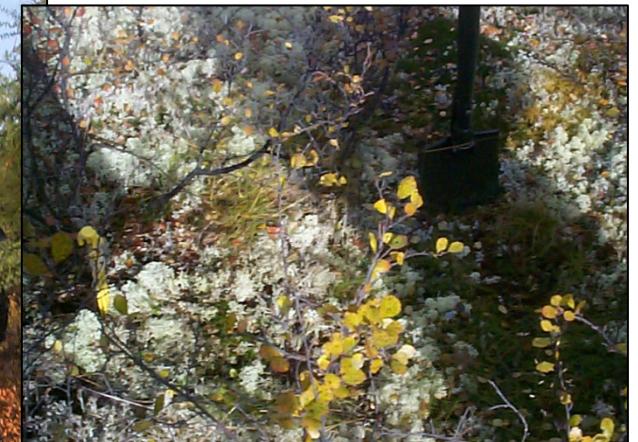
Sensor #6





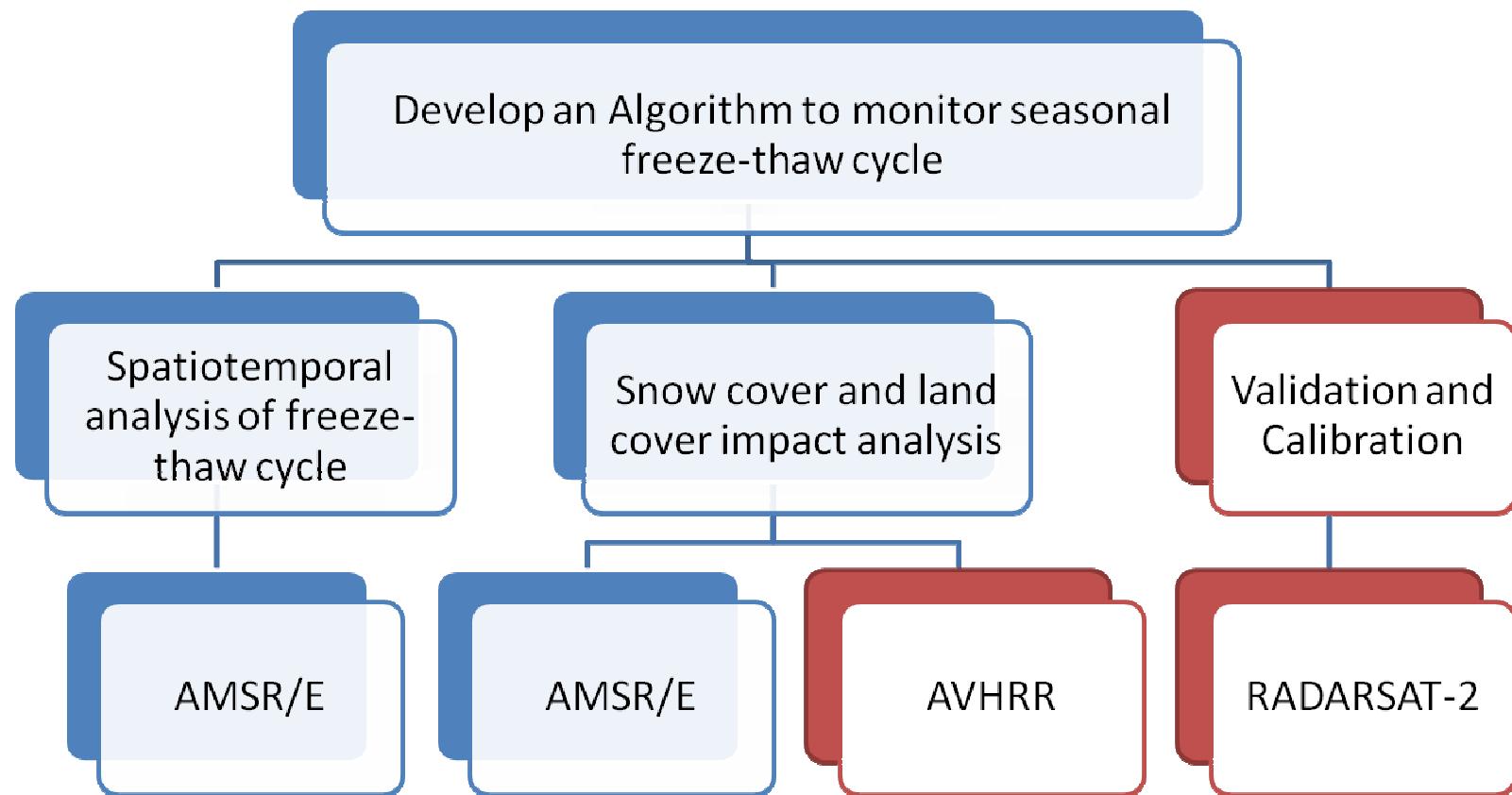
58°12.771N ; 68°21.962W

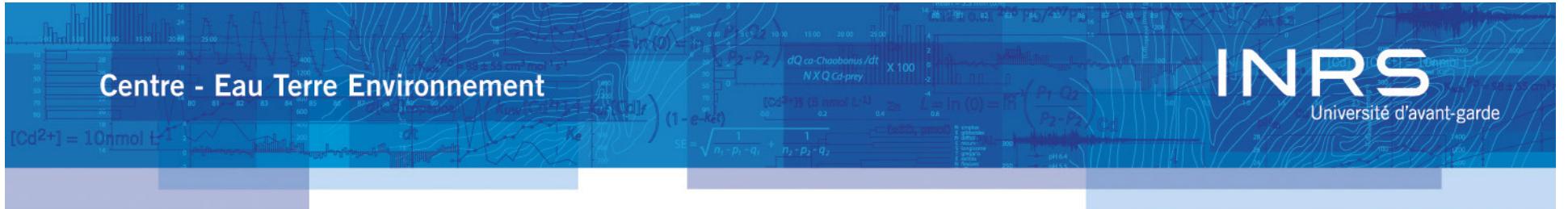
Boisé mélèzes assez dense
Lichen et arbustes
Sable fin
Derrière les 2 grosses roches



Sensor #1

OBJECTIVES





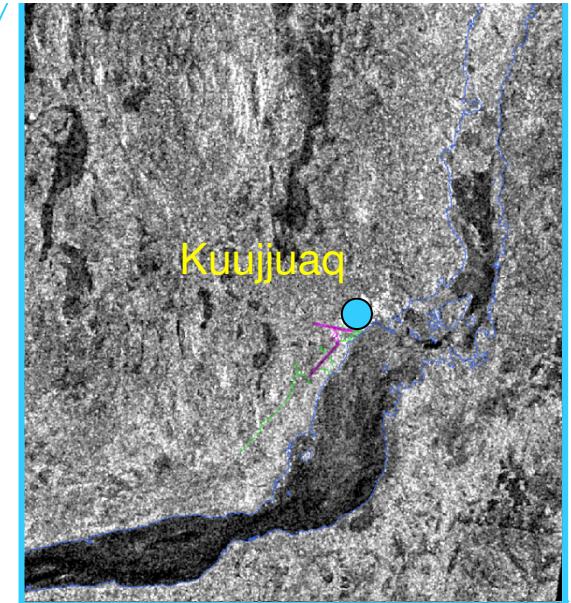
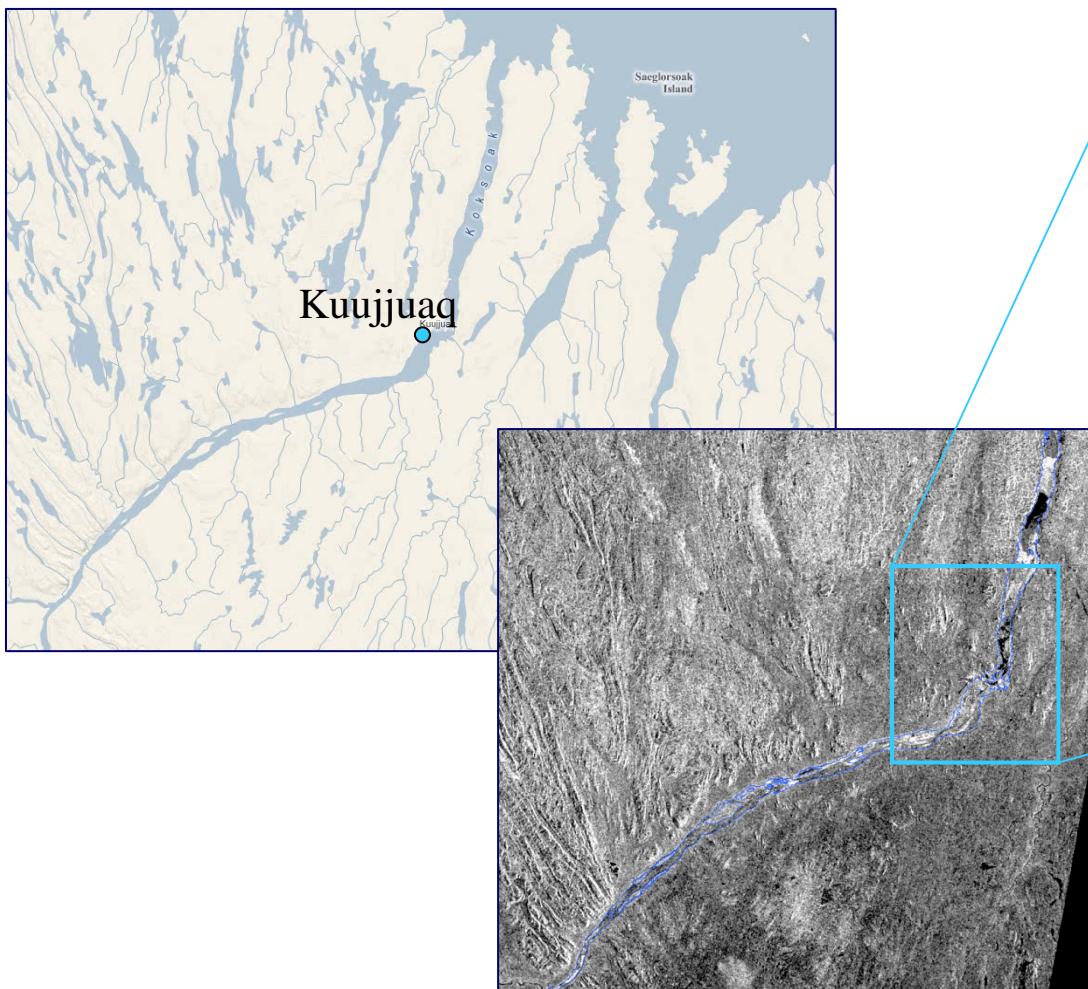
SATELLITE DATA : Passive Microwave Data

- Brightness Temperature (Tb)

SATELLITE	SENSOR	FREQUENCY	RESOLUTION
EOS-AQUA	AMSR-E	18,7 GHZ V 36,5 GHZ V	25 km
Product: AMSR-E/Aqua Daily L3 Surface Soil Moisture, InterpretiveParms, & QC EASE-GRIDS			
Source: EOS Data Gateway http://nsidc.org/~imswww/pub/imswelcome/index.html			

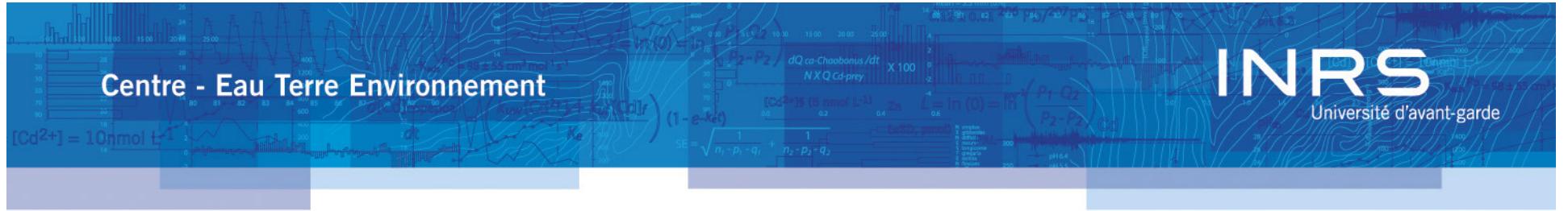
Spécifications de l'AMSR-E. Source : Jones, 2007

Fréquence (GHz)	6,9	10,7	18,7	23,8	36,6	89
Résolution (Km)	60	60	25	25	15	5
Largeur de bande (MHz)	350	100	200	400	1000	3000



RADARSAT-1 Kuujjuak

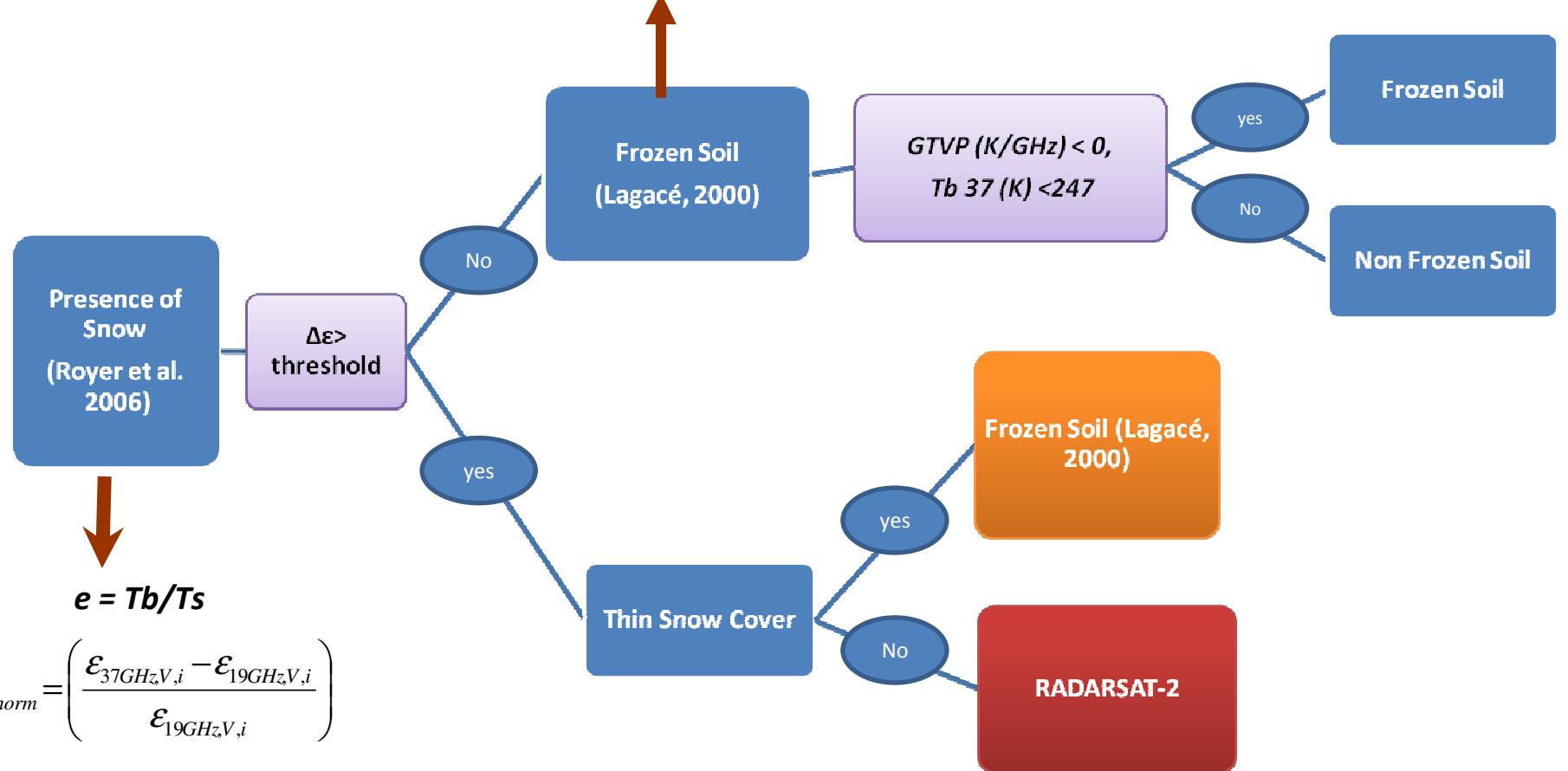
RADARSAT-1 image of the Koksoak
River, May 14, 2007

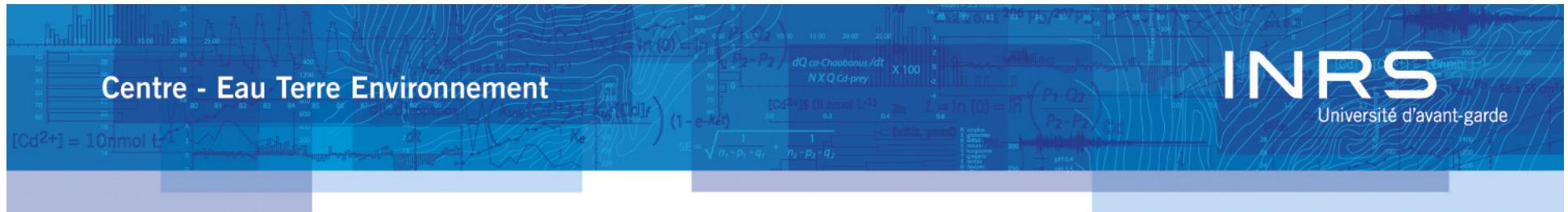


$$GTVP = \{(T_{b37GHzV} - a_i) - (T_{b19GHzV} - a_i)\} / df \quad a_i = m_{LR} * P_j$$

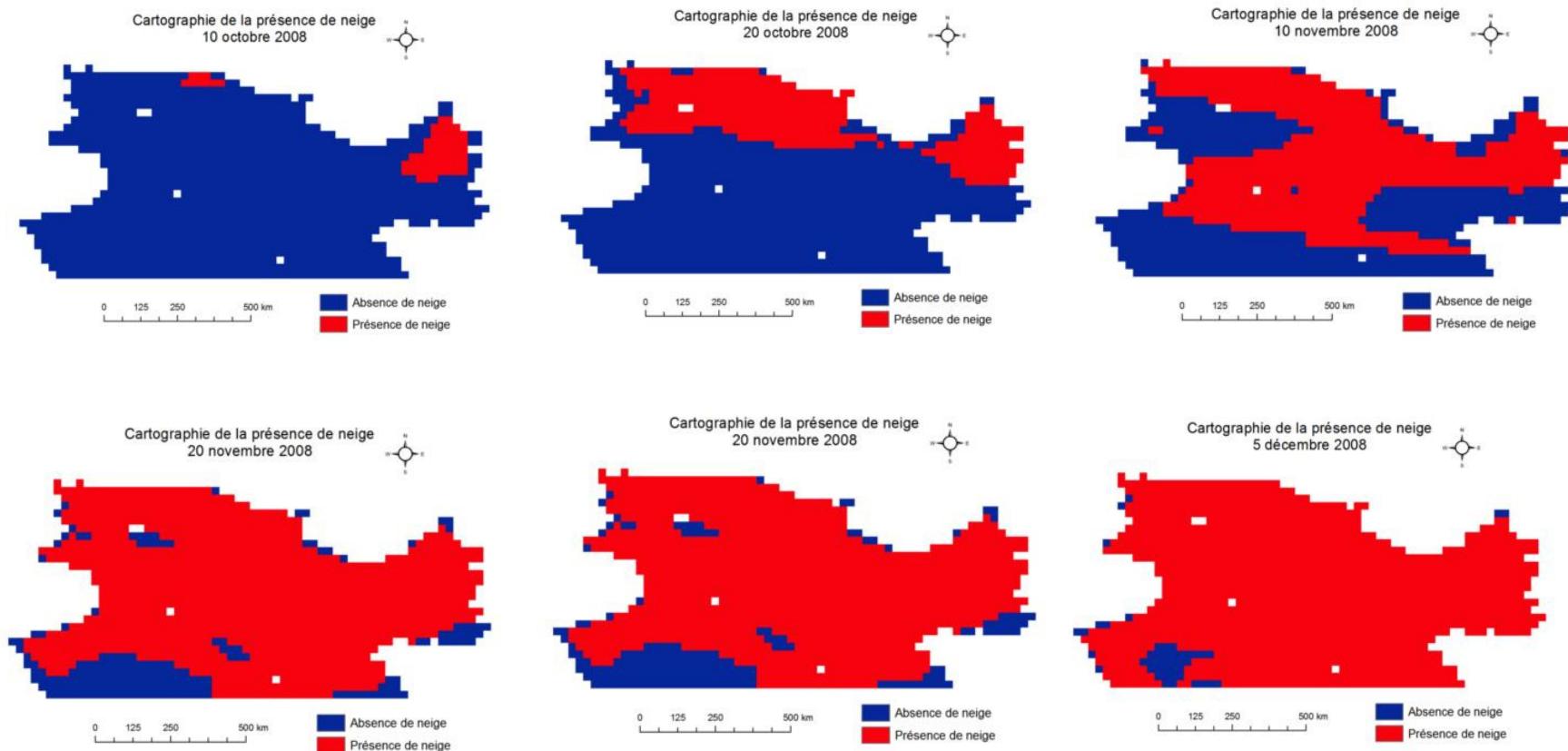
METHODOLOGY :

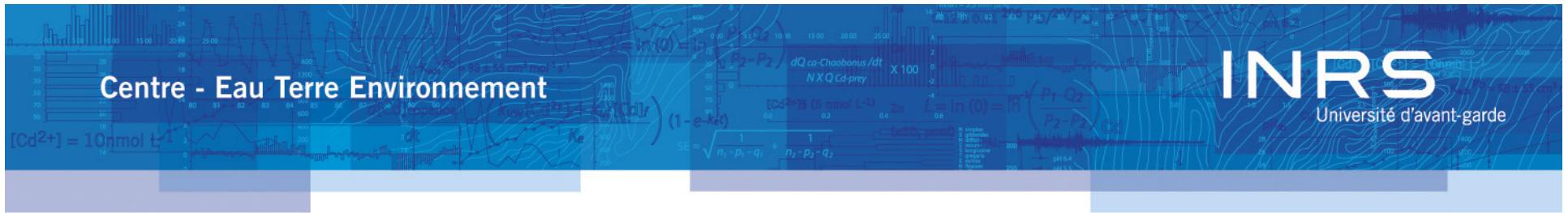
$$T_{b37GHzV} = (T_{b37GHzV} - a_{i37GHz,V})$$



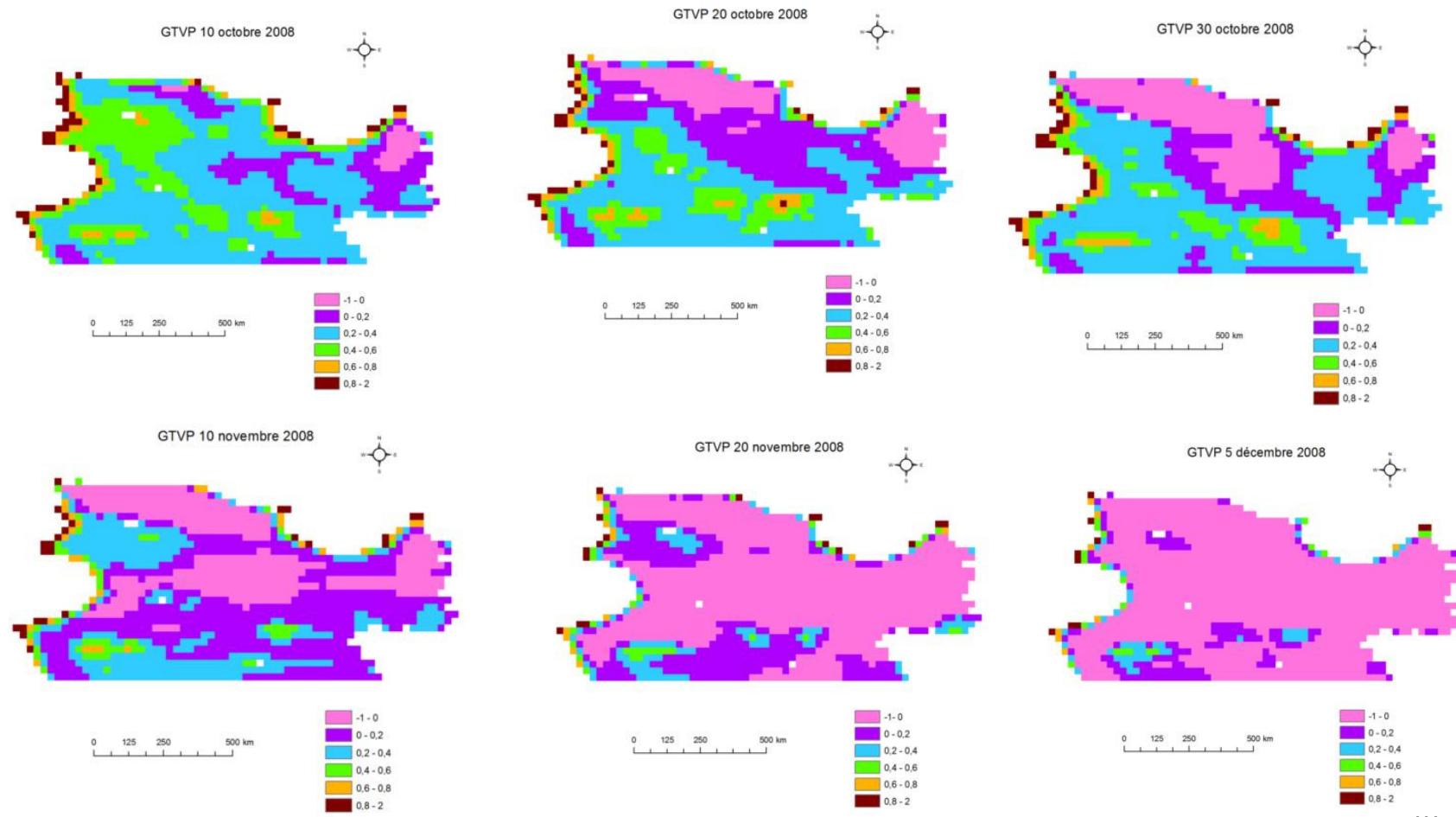


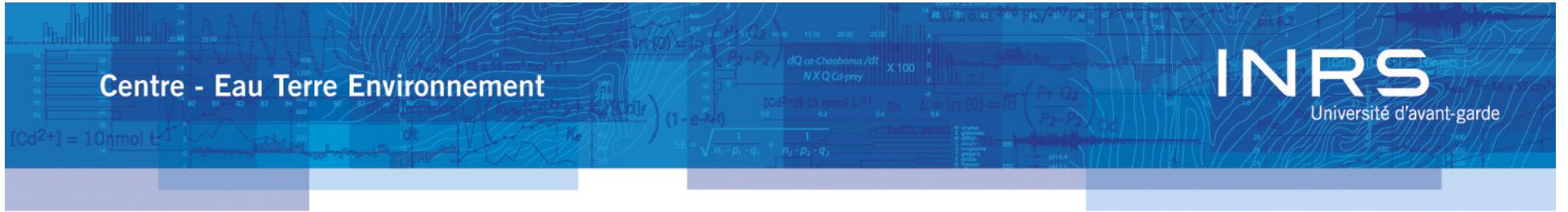
1) Mapping of Snow Cover extension from AMSR-E



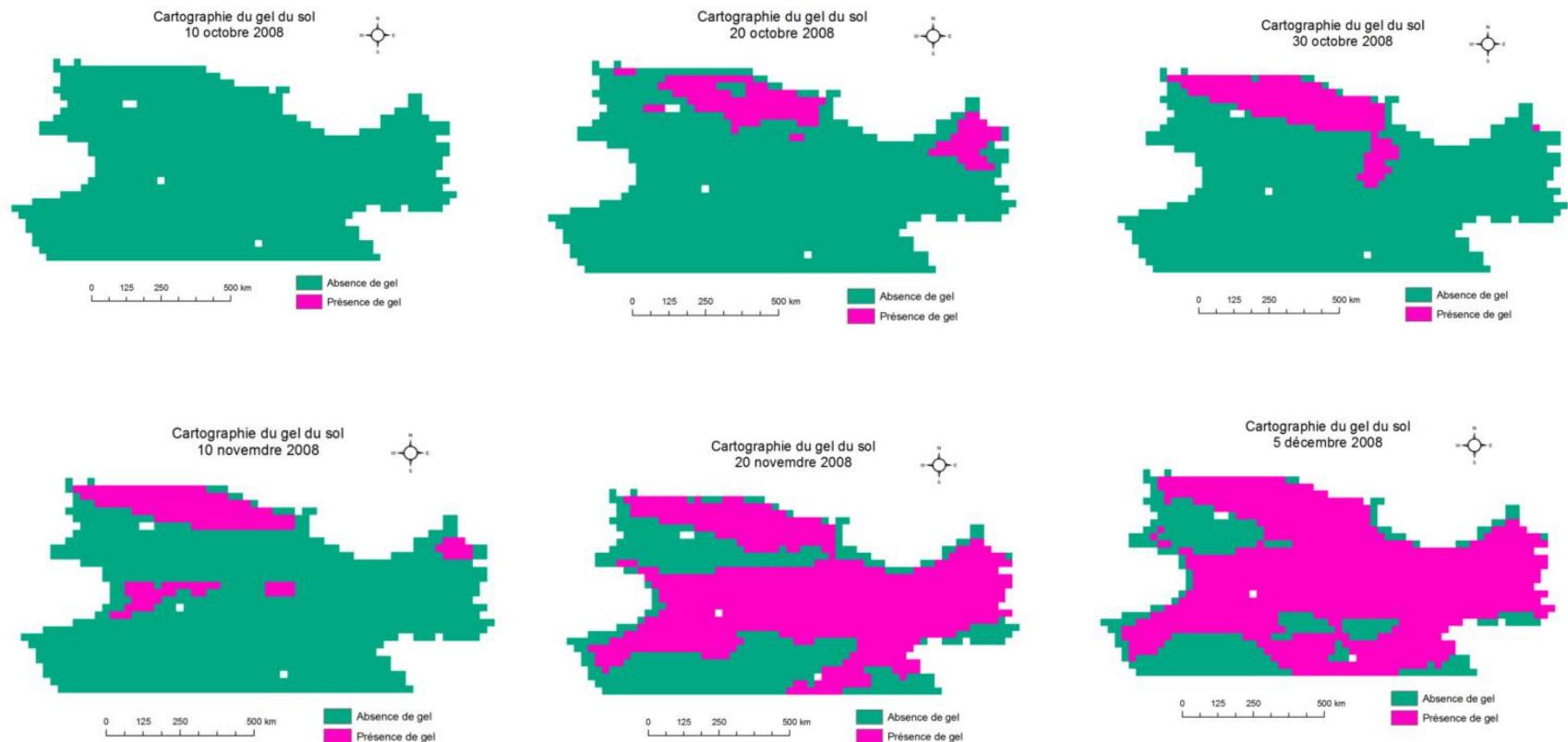


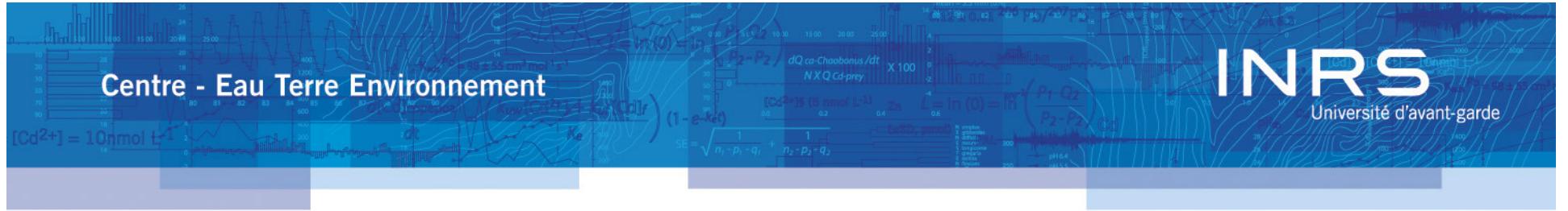
2) GTVP: Temporal and Spatial variation of frozen ground





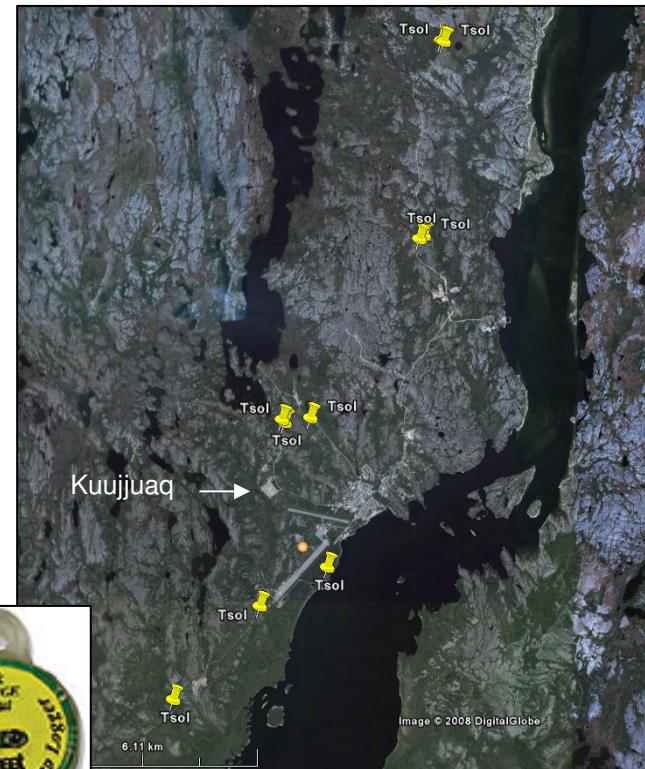
3) Mapping of Frozen Ground from AMSR-E

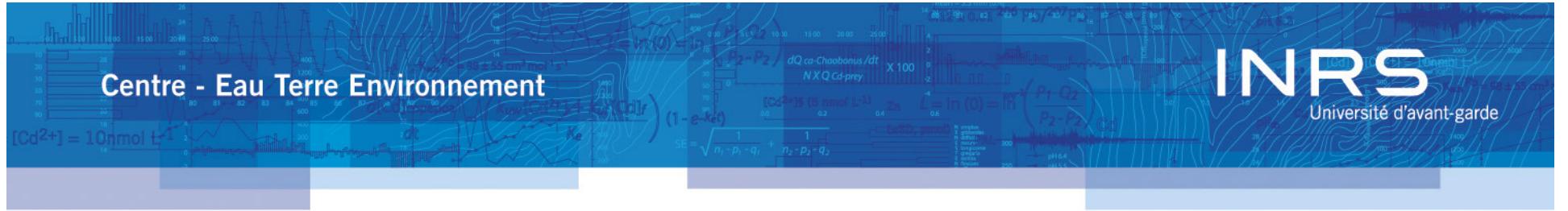




What's next.....

- RADARSAT-1 and RADARSAT-2 Data with High Resolution and Multi Polarisation for Validation of results
- IN-SITU Data for Calibration and Validation





THANK YOU